Chapter 3
Impact of Generic Fluid Milk and Dairy Advertising and Promotion on Dairy Markets: An Independent Analysis

The Dairy Production and Stabilization Act of 1983 (Dairy Act; 7 U.S.C. 4514) and the Fluid Milk Promotion Act of 1990 (Fluid Milk Act; 7 U.S.C. 6407) require a yearly independent analysis of the effectiveness of milk industry programs. These promotion programs operate to increase milk awareness and thus the sale of fluid milk and related dairy products. From 1984 through 1994, USDA was responsible for the independent evaluation of the Dairy Program, as authorized by the Dairy Act, and issued an annual Report to Congress on the effectiveness of the Dairy Program. Beginning in 1995, the Congressional report began including third-party analyses of the effectiveness of the Dairy Program in conjunction with the National Fluid Milk Processor Promotion Program (Fluid Program) authorized by the Fluid Milk Act. Since 1998, these independent analyses have been conducted by agricultural economists from Cornell University.

While both programs utilize various types of marketing strategies to increase fluid milk and cheese consumption, the first section of this chapter focuses solely on media advertising impacts since advertising remains an important marketing activity. The effects of fluid milk advertising under both programs are combined because the objectives of both programs are the same, and data cannot be satisfactorily segregated to evaluate the two programs separately. An evaluation of the effectiveness of cheese advertising by the Dairy Program is conducted separately.

The second section of this chapter adopts a new modeling approach to account for both generic advertising and other nonadvertising promotion expenditures in relation to combined fluid milk and cheese demand enhancement. While the available data are more limited, the supplemental modeling work provides a more complete model of all funded promotion activity.

Highlights

Generic fluid milk and dairy product advertising conducted under the Dairy and Fluid Programs had a major impact on dairy markets. Over the period 1999–2003, on average, the following market impacts would have occurred if the advertising under the Fluid Program had not been in effect, and advertising under the Dairy Program had been equal to its level the year prior to the enactment of that national mandatory program:[1]

- Fluid milk consumption would have averaged 4.5 percent lower annually.
- Cheese consumption would have averaged 1.2 percent lower annually.

[1] It is important to note that some States conducted generic milk and cheese advertising prior to passage of the Dairy Production and Stabilization Act of 1983, which authorized the Dairy Program. As such, to measure the advertising impacts of the Dairy Program, this study simulated and compared market conditions with the Dairy Program versus market conditions reflecting advertising funding levels prior to enactment of the Dairy Program. Throughout this report, any scenario referring to the absence of the Dairy Program reflects advertising funding at levels prior to enactment of the Dairy Program.

- Total consumption of milk in all dairy products would have averaged 2.0 percent lower annually, or roughly 3.4 billion pounds on a milkfat equivalent basis.
- The average price received by dairy farmers would have averaged 7.6 percent, or $1.01 per hundredweight, lower annually.
- Commercial milk marketings by dairy farmers would have averaged 2.1 percent lower annually.

Over the same period, the following market impacts would have occurred if the Dairy Program had not been in existence but the Fluid Program had been, and advertising expenditures by dairy farmers were equal to the level that existed the year prior to enactment of the Dairy Program:

- Fluid milk consumption would have averaged 0.6 percent lower annually.
- Cheese consumption would have averaged 1.8 percent lower annually.
- Total milk consumption of all dairy products would have averaged 0.9 percent lower annually, or roughly 1.5 billion pounds on a milkfat equivalent basis.
- The average price received by dairy farmers would have averaged 2.9 percent, or $0.39 per hundredweight, lower annually.
- Commercial milk marketings by dairy farmers would have been 1.0 percent lower annually.

An average benefit-cost ratio (BCR) for the Dairy Program was estimated for the period 1999–2003 for both advertising and all demand-enhancing marketing activities. The results indicated that:

- The average BCR for the Dairy Program relative to the generic advertising program was 6.58, i.e., each dollar invested in fluid milk and cheese advertising returned $6.58 in revenue to dairy farmers on average.
- The average BCR for the Dairy Program relative to all marketing activities (advertising and nonadvertising promotion activities) was 4.61, i.e., each dollar invested in the aggregate marketing program returned $4.61 in revenue to dairy farmers on average.

Section I: Analysis of Fluid Milk and Cheese Advertising

Most economic models used to evaluate the effects of generic advertising programs over time measure the average impacts of various factors on demand. These "constant-parameter" models may be problematic when the time period covered is relatively long and/or the marketing environment has sufficiently changed over time. For example, this report is based on data since 1975; consequently, constant parameter demand models would estimate (among other variables) the effect of generic fluid milk and cheese advertising as an average point estimate over the 29-year period ending in 2003. Depending on the research objectives, mean-response estimates are entirely appropriate; however, a mean-response model may not accurately convey the current degree of advertising effectiveness if sufficient changes have occurred in market environments, population profiles, and eating behavior over time. In addition, advertising messages have changed, two national programs have been instituted more than a decade apart, and State and regional programs have become more coordinated since the inception of the generic advertising programs.

An alternative approach to measuring the impacts of advertising, given a long history of time series data, is to use a "time-varying parameter" model. This type of model measures how the impact of demand factors, including generic advertising, varies over time. Similar to the approach of last year, this year's economic study adopts such a model. Thus, the analysis examines how the general effectiveness of generic fluid milk and cheese advertising has changed over time and identifies important factors that have influenced the changes in advertising effectiveness over time.

In order to simulate the impacts of generic advertising over time, the retail demand impacts must be measured along with other appropriate processor and farm market supply-side responses. The model embodies a significant level of disaggregation of the U.S. dairy industry. For instance, the dairy industry is divided into retail, wholesale (processing), and farm markets, and the retail and wholesale markets include fluid milk and cheese separately. This report emphasizes the results of the demand model. The model simulates market conditions with and without the Dairy and Fluid Programs.

Factors Affecting the Demand for Fluid Milk and Cheese

Because there are many factors that influence the demand for fluid milk and cheese besides advertising, an econometric model was used to identify the effects of individual factors affecting the demand for these products. The following variables were included as factors influencing per capita fluid milk demand: the Consumer Price Index (CPI) for fluid milk, the CPI for nonalcoholic beverages used as a proxy for fluid milk substitutes, per capita disposable income, the percentage of the U.S. population less than 6 years old, the percentage of the U.S. population that is African American, variables to capture seasonality in fluid milk demand, a trend variable to capture changes in consumer tastes for fluid milk over time, expenditures on branded fluid milk advertising, and expenditures on generic fluid milk advertising.

The following variables were included as factors influencing per capita cheese demand: the CPI for cheese, the CPI for meat used as a proxy for cheese substitutes, per capita disposable income, per capita food away from home (FAFH) expenditures, the percentage of the U.S. population that is ethnically Hispanic or Asian; the percentage of the U.S. population between 20 and 44 years old, variables to capture seasonality in cheese demand, a trend variable to capture changes in consumer tastes for cheese over time, expenditures on branded cheese advertising, and expenditures on generic cheese advertising.

The model was estimated with national, quarterly data from 1975 through 2003. To account for the effects of inflation, all prices and income were deflated. Branded and generic fluid milk and cheese advertising expenditures were deflated by a media cost index computed from information supplied by DMI on annual changes in advertising costs by media type. Because advertising has a carry-over effect on demand, past advertising expenditures also were included in the model as explanatory variables using a distributed-lag structure.

Unlike constant-parameter models, which measure the average impact of each factor on milk and cheese demand, the time-varying parameter model used in this report measures each demand factor's impact on a quarterly basis. Moreover, the model used here is able to identify the factors that were most important to the variation of advertising response over time. The model not only allows measurement of the magnitude of each demand factor, but also estimates changes in the magnitude and the causes of changes over time. The generic advertising parameter estimates are compared both across time and across products.

The relative impacts of variables affecting demand can be represented with what economists call "elasticities." Elasticities measure the percentage change in per capita demand given a one-percent change in one of the identified demand factors. Table 3–1 provides selected average

Table 3–1. Average Elasticity Values (1999–2003) for Factors Affecting the Retail Demand for Fluid Milk and Cheese.[1]

Demand Factor	Fluid Milk	Cheese
Retail price	–0.098*	–0.272*
Per capita income	0.536*	0.514*
Per capita food-away-from-home expenditures	n.a.	0.118*
Percent of population age < 6	0.794*	n.a.
Percent of population age 20–44	n.a.	0.290**
Percent of population African American	–0.373**	n.a.
Percent of population Hispanic/Asian	n.a.	0.758*
Generic advertising	0.037*	0.035*

[1] Example: A 1.0 percent increase in the retail price of cheese is estimated to reduce per capita sales of cheese by 0.272 percent. Note: n.a. means not applicable. For more information on the data used to estimate these elasticities, see Table 3–5. *Statistically significant at the 10 percent significance level or less. **Statistically significant at the 15 percent significance level.

elasticities over the most recent 5-year period. For example, the price elasticity of demand for cheese equal to –0.272 means that a one-percent increase in the real, inflation-adjusted, cheese price decreases per capita cheese quantity demanded by 0.272 percent.

Based on the computed elasticities, the most important factors influencing per capita fluid milk demand are: (1) the percentage of the population under 6 years of age, (2) per capita disposable income, and (3) the percentage of the population that is African American. Similarly, the most important factors influencing per capita cheese demand include: (1) the percent of the population that is ethnically Hispanic or Asian, (2) per capita disposable income, (3) the retail cheese price, (4) the percent of the population that is 20–44 years of age, and (5) per capita expenditures on FAFH.

The relative amount of variation in these elasticities over time differs by demand factor. While Table 3-1 presents these elasticities evaluated over the most recent 5-year time period, the forthcoming discussion will also elaborate on how these elasticities have varied over time. Although the principal focus of this report is on generic advertising elasticities for fluid milk and cheese, we briefly explore time-varying response levels for selected demand variables as well.

Price

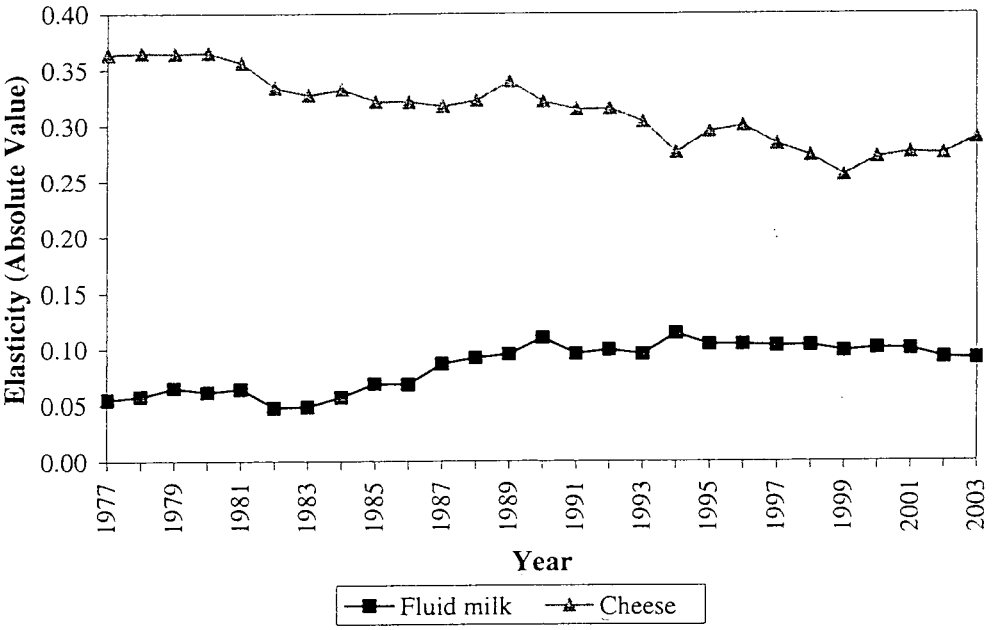
The demand response for fluid milk to changes in real prices has been consistently inelastic; i.e., consumers are relatively insensitive to changes in price. Given the nature of the product as a staple, this is expected. The estimated elasticities have increased from -0.050 early in the sample time period to a peak of around –0.114 in the early 1990s. Modest reductions have occurred since with a current 5-year average of –0.098 (Figure 3–1). The implication of price elasticities at or below –0.114 is that fluid milk demand has consistently been insensitive to real price changes over time, which is a result consistent with the majority of empirical studies of fluid milk demand.

Price elasticities for cheese have shown a modestly declining trend over time, indicating consumers are becoming less responsive to changes in price; however, elasticity estimates are well above those estimated for fluid milk and have been increasing more recently (Figure 3–1). The mean-response estimate of –0.272 in Table 3–1 can be compared with levels around –0.360 in the late 1980s, and –0.330 in the late 1970s. The current annual price elasticity of demand for 2003 is –0.289; i.e., a 1.0 percent increase in the real cheese price results in a 0.289 percent decrease in per capita cheese disappearance. As Figure 3–1 demonstrates, the margin between the levels of price response between fluid milk and cheese over time has decreased from around 0.30, early in the sample time period, to around 0.20 currently.

Income

Income elasticities for fluid milk had relatively strong growth early in the sample time period but have been modestly declining over the last few years (Figure 3–2). The current income elasticity estimate for fluid milk is slightly below the 5-year average estimate in Table 3-1. In 2003, a 1.0 percent increase in disposable (inflation-adjusted) income resulted in an average 0.522

Figure 3–1. Annual Price Elasticities for Fluid Milk and Cheese

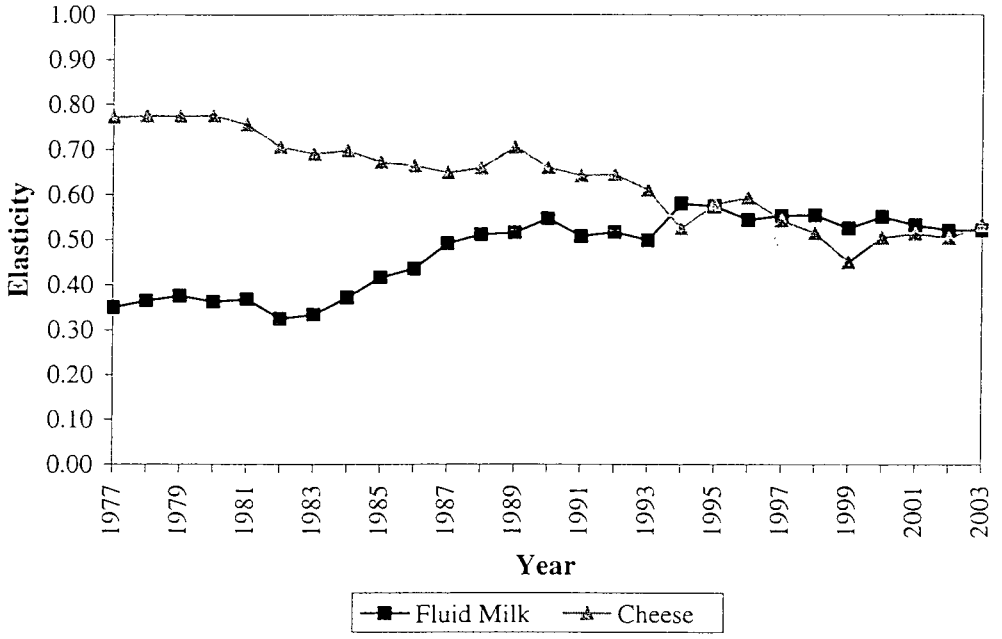


percent increase in per capita fluid milk demand. Five-year response estimates indicate that a 1.0 percent increase in real per capita disposable income will increase per capita cheese demand by 0.514 percent (Table 3–1). Relative to fluid milk, income elasticities for cheese have trended downward and have been less variable (Figure 3–2). In fact, the gradual downward trend in income elasticities for cheese, combined with the increasing trend for fluid milk early in the sample period, has resulted in income elasticity estimates that are roughly equivalent. Stronger levels of income response, compared to that of price, may be indicative of gains in disappearance from purchases of more value-added products, relative to reactions to price changes of products in general. While still inelastic, relatively strong income elasticities for fluid milk and cheese are intuitively attractive to future changes in per capita disappearance as real income levels have continued to rise.

Age Demographics

While the youngest-age cohort in the United States still remains an important factor affecting fluid milk demand, this elasticity has declined from approximately 1.000 in 1994 to a current value of approximately 0.735 (Figure 3–3). The 5-year mean-response estimate of 0.794 in Table 3–1 is indicative of the historically strong demand component from this young age cohort. The current elasticity estimate implies that for every 1.0 percent decline in the proportion of the U.S. population under the age of six, there is a 0.735 percent decrease in per capita fluid milk demand (Figure 3–3). Of all factors included in the model, this was the most important in terms of effects on fluid milk demand.

Figure 3–2. Annual Income Elasticities for Fluid Milk and Cheese



As hypothesized, the middle-aged population cohort (ages 20 through 44) was shown to be positively correlated with per capita cheese disappearance (0.290), though with a somewhat lower level of statistical significance (Table 3–1).[2] However, the time-varying results do demonstrate continued modest gains in this cohort effect over time, albeit relatively stable since 2000 (Figure 3–3).

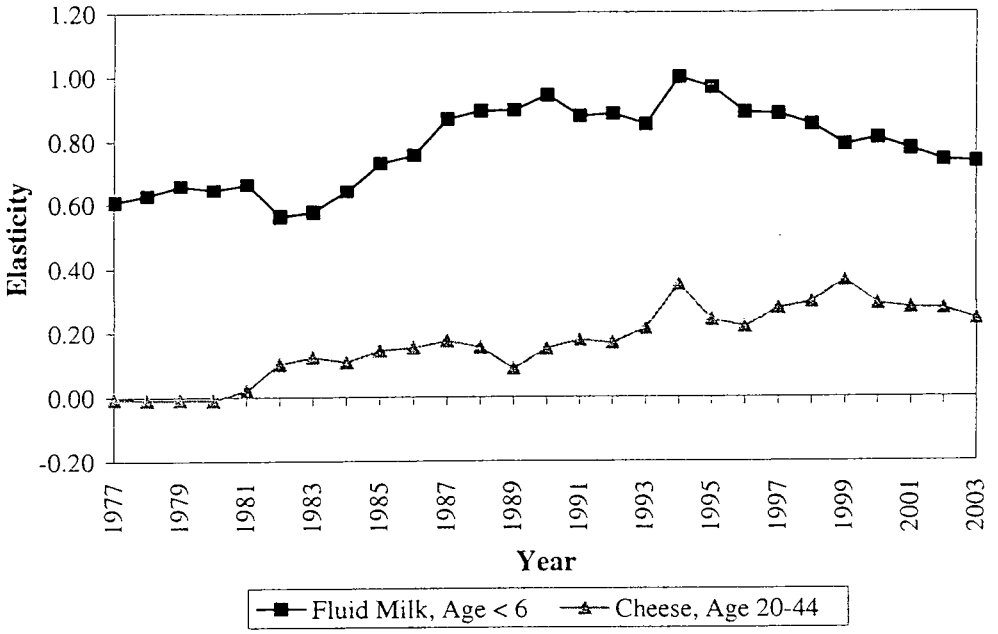
Race/Ethnicity Demographics

The lower per capita fluid milk demand of African Americans relative to the rest of the population is well recognized. The demand elasticity in Table 3–1 indicates that a 1.0 percent increase in the proportion of the population that is African American has resulted in an average decrease in per capita fluid milk demand of –0.373 percent; however, the degree of statistical confidence is somewhat lower. Modest reductions in the impact of this factor have occurred since the mid-1990s, offsetting some of the gains in its impact through the 1980s (Figure 3–4). The current demand elasticity of –0.336 for this cohort proportion is similar to the 5-year mean estimate.

The impact of changes in the Hispanic and Asian populations was strongly correlated with increases in per capita cheese disappearance. On average, a 1.0 percent increase in percent of the population identified as Hispanic or Asian increased per capita cheese disappearance by

[2] The level of significance can generally be interpreted as a confidence measure. For example, at the 10 percent significance level, we are 90 percent confident (100–10) that the estimate is statistically different from zero. As such, the lower the significance level, the higher the degree of confidence in the empirical estimates.

Figure 3–3. Annual Age Composition Elasticities for Fluid Milk and Cheese

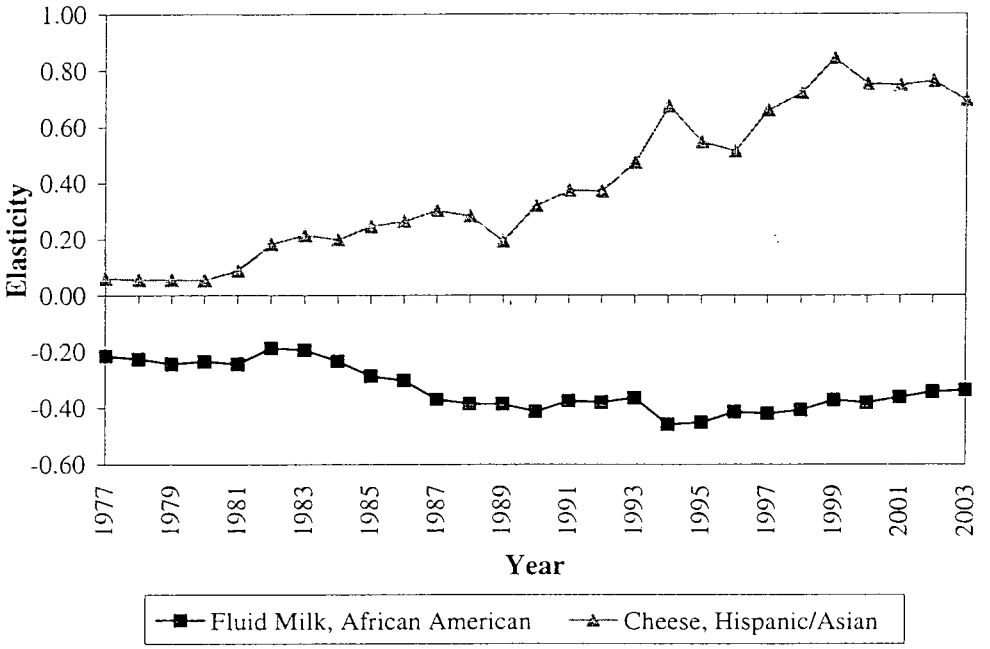


0.758 percent over the past 5 years (Table 3–1). The strong growth in elasticity estimates is due in part to the consistently strong growth in this cohort population since 1990 (Figure 3–4). Of all factors considered in the cheese demand model, this was the most important in terms of magnitude of effects on demand.

Food Spending Behavior

Given that approximately two-thirds of national cheese disappearance is consumed in sectors away from home, it is not surprising that per capita expenditures on FAFH are related to commercial per capita cheese disappearance. On average, a 1.0 percent increase in per capita expenditures on FAFH resulted in a 0.118 percent increase in cheese demand over the last 5 years (Table 3–1). The positive contribution to per capita disappearance is largely captured by cheese usage in restaurants, particularly in fast-food businesses with burger, taco, and pizza products. The overall impact of FAFH expenditures to per capita cheese disappearance has been decreasing due, in part, to a flattening of real per capita FAFH expenditures since the early 1990s. This factor may also continue to decrease in importance as fast-food establishments react to negative press about their menus and as cheese prices rise.

Figure 3–4. Annual Race Elasticities for Fluid Milk and Cheese



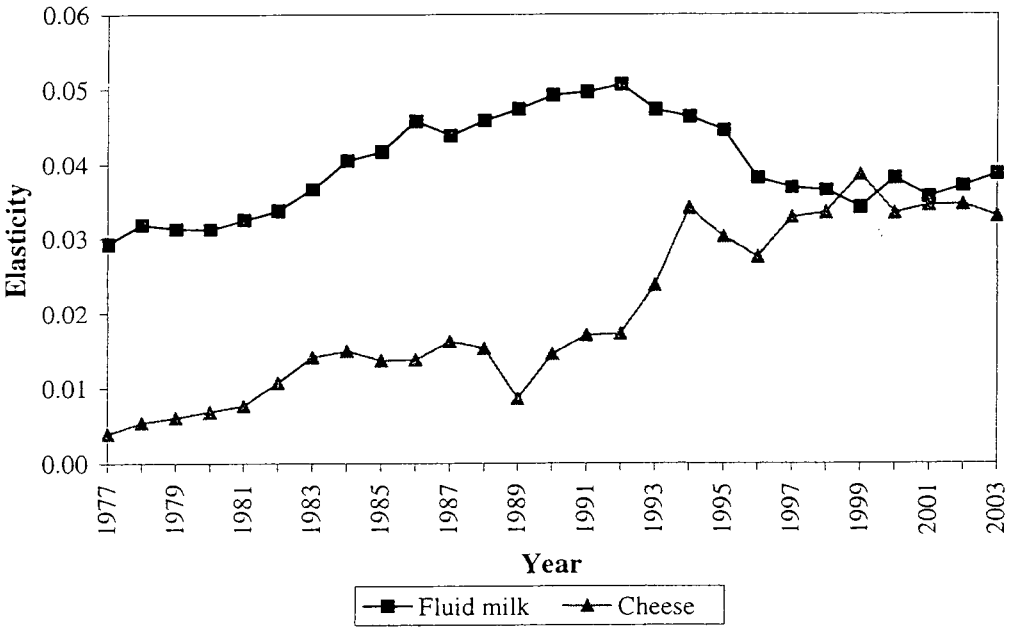
Advertising Effects

Branded advertising expenditures for both fluid milk and cheese did not significantly contribute to total per capita disappearance. While any advertising objective includes increasing sales, branded advertising efforts heavily concentrate their efforts on gaining market share from their competitors. Branded fluid milk advertising expenditures are relatively small compared to their generic counterparts; however, cheese has considerably more branded advertising expenditures. In any event, neither demand model exhibited a response on total per capita disappearance that was significantly different from zero.

While branded advertising efforts did not demonstrate significant impacts on overall demand, generic advertising was positive and significant for both fluid milk and cheese demand (Table 3–1).[3] Five-year average generic advertising elasticities for fluid milk and cheese show only a modest difference of 0.037 for fluid milk and 0.035 for cheese; however, elasticity estimates for both products have shown substantial variation over time (Figure 3–5). Generic advertising elasticities for cheese, in particular, have shown reasonably strong growth over time,

[3] It is hypothesized that advertising of pizza and cheeseburgers has a positive effect on the consumption of cheese. Such variables were not included in the model due to a lack of data. Assuming that pizza and cheeseburger advertising has a significantly positive effect on cheese consumption, omission of these variables could result in the impact of generic cheese advertising's being somewhat overstated.

Figure 3–5. Annual Generic Advertising Elasticities for Fluid Milk and Cheese



while strong gains in fluid milk advertising response through the early 1990s have been largely offset by reductions in the latter half of the 1990s.[4]

Both products demonstrated significant increases in generic advertising elasticities up to the early to mid-1990s. However, since 1993, fluid milk generic advertising elasticities have shown a decreasing trend, albeit a relatively flat one since 1996 (Figure 3–5). With the exception of two more pronounced spikes in 1994 and 1999, generic cheese advertising elasticities have gradually trended upwards over the entire sample period and ranged from 0.004 to 0.039. While the increase in 1999 (due mostly to an abrupt increase of the population proportion of Hispanic and Asians in the data) was not statistically significant, the increase in 1994 was significant and reflects a sizable decrease in real per capita FAFH expenditures. Currently, the generic advertising elasticity for cheese is 0.034.

Fluid milk generic advertising elasticities increased from around 0.029 at the beginning of the sample period to 0.051 in 1992. Growth in advertising elasticities over this time was due in large part to strong gains in the population proportion of the youngest age cohort, a strong demand component, and a primary marketing target (including parents of young children) of the

[4] Recall that the econometric model hypothesizes that changes in market and demographic environments will affect the level of response to generic advertising. The relative change in generic advertising response then depends on both the signs and relative sizes of the parameter estimates and changes in the levels of the market and demographic variables. We highlight briefly some of the contributing factors here in relation to Figure 3–5, with a further discussion later identifying the important factors affecting changes in generic advertising response over time.

advertising programs. Reductions in the mid- to late 1990s reflect, in large part, reductions in this cohort's population proportion over time. Currently, the fluid milk generic advertising elasticity is 0.039.

The historical gap between the generic advertising elasticities for the two products is no longer apparent. Previous constant-parameter studies have consistently shown generic advertising elasticities for cheese demand below that for fluid milk demand. Average estimates of the time-varying response levels here over the entire sample period would be consistent with those results. Statistical tests were performed to see what differences in estimates are significantly different from zero across products and across time since 1990. We summarize those results here.

First, we compare whether the fluid milk and cheese generic advertising elasticities are statistically different. Comparing the differences in elasticities since 1990, the large gap that existed from 1990–1996 statistically holds up, i.e., fluid milk generic advertising elasticities were statistically above those of their cheese counterparts. Since 1997, however, the levels of generic advertising response between fluid milk and cheese have not been statistically different from one another.

Now we compare how significant changes in the levels of elasticities are for both products over time. In general, more recent changes in advertising response (i.e., since 1994 for fluid milk and since 1993 for cheese) are not statistically different from one another. However, clear differences exist between response levels in the early 1990s.

Generic advertising elasticities for fluid milk began to drop significantly after 1994. However, in 1995 real fluid milk advertising expenditures, while offset some by shifts to generic cheese advertising, increased with the addition of advertising expenditures from the milk processor promotion program. Since that time, the changes in fluid milk advertising response have flattened out considerably, and in fact, the visual decline evident from Figure 3–5 since 1994 is not statistically significant. Generic cheese advertising elasticities have shown strong growth since 1990 and, while changes since 1993 are not statistically significant, there exist significant differences from the beginning of the decade to currently.

Factors Affecting Generic Advertising Effectiveness

Allowing advertising response to vary over time is important, but knowing what factors contributed to that variation, and by how much, provides valuable information for crafting future strategies, changing the advertising focus, or altering preferred target audiences. The model used in this study allows not only for advertising response to vary over time, but also provides information on the relative importance of factor variability that determines changes in advertising response levels.

We can derive these impacts mathematically from the time-varying parameter model specification, and we refer to them as generic advertising response elasticities (GARE). That is, we can derive the percentage change in the long-run generic advertising elasticity with respect to a change in the level of another variable. For example, how are generic advertising elasticities

affected by changes in real income or by changes in food expenditure patterns? The signs of the GAREs provide useful information for product marketers in crafting future market strategies.

Average GAREs since 1999 are presented in Table 3–2. Relative to the other variables, GAREs with respect to price are lower and less significant. The positive sign on the cheese estimate would seem to contradict advertising and marketing theory, which generally concludes that advertising is more effective during price promotion periods. It is more likely the case that this characteristic cannot be gleaned clearly from these results given the aggregate nature of the data at hand. Indeed, the elasticity with respect to the cheese price is not significantly different from zero.

Changes in the proportion of the population under age 6 and real per capita income have primarily driven changes in the level of fluid milk generic advertising response. The positive demand relationship for the young age cohort (Table 3–1) indicates this group consumes more fluid milk per capita, and the positive GARE (Table 3–2) indicates that this cohort (or parents of this cohort) are more responsive to the advertising messages. This result is consistent with current advertising efforts aimed at young children, and it follows, then, that strategies targeting this cohort would be an effective approach to increasing advertising response.

The positive sign on the income variable for fluid milk also provides evidence that targeting middle- to upper-income households may be beneficial (Table 3–2). The income effect for cheese was not statistically significant. However, the negative sign may be related to the correlation in eating behavior as incomes rise with purchasing more prepared or ready-to-eat foods or eating more food away from home—areas not primarily targeted in past generic advertising messages.

The negative fluid milk demand impact from African Americans (Table 3–1) appears reinforced with a lower level of advertising responsiveness (Table 3–2). This direct relationship between

Table 3–2. Average Generic Advertising Response Elasticities (GARE), 1999–2003 [1]

Variable	Fluid Milk GARE	Cheese GARE
Retail price	−0.826*	1.263
Per capita income	2.923*	−3.539
Per capita food-away-from-home expenditures	n.a.	−9.520**
Percent of population under 6 years of age	4.625**	n.a.
Percent of population 20–44 years of age	n.a.	3.030*
Percent of population African American	−3.069*	n.a.
Percent of population Hispanic/Asian	n.a.	8.622**

[1] Interpreted as the percentage change in the long-run generic advertising elasticity for a 1.0 percentage unit change in the associated variable. Note: n.a. means not applicable.
*Significant at the 15 percent significance level. **Significant at the 10 percent significance level or less.

demand and advertising response impacts is also demonstrated by the Hispanic/Asian variable for cheese. The combined Hispanic and Asian population proportion has increased over 9 percent since 1999, and it appears that this segment of the population is more responsive to the advertising message. Targeting these race and ethnic cohorts would seem an effective strategy to increase the level of generic cheese advertising response.

The positive GARE for the middle-aged cohort for cheese indicates this to be a preferred population segment at which to target advertising programs, as with the youngest age cohort for fluid milk. However, the direct relationship between demand response and advertising response does not appear to hold for households consuming cheese away from home, i.e., as consumers spend more on food eaten away from home, generic cheese advertising elasticities fall (Table 3–2). While a large share of cheese disappearance is in the FAFH sector, nearly all generic cheese advertising is focused on at-home consumption. As such, it is reasonable to expect that as consumers spend more of their budget away from home, the current generic cheese advertising message becomes less effective or is at least less correlated with total cheese consumption. If per capita FAFH expenditures are expected to increase in the future, then shifting generic cheese advertising toward the away-from-home market may be appropriate.

Impact of the Dairy and Fluid Milk Advertising Programs

To evaluate market impacts of the Dairy and Fluid advertising programs, the economic model was simulated over a 5-year time period from 1999 through 2003. These two programs are complementary in that they share a common objective—to increase fluid milk sales. To accomplish this objective, both programs invest in generic fluid milk advertising, which is different from brand advertising in that the goal is to increase the total market for fluid milk rather than a specific brand's market share. In the evaluation of the programs, it is assumed that a dollar spent on fluid milk advertising by dairy farmers has the same effect on demand as a dollar spent by processors on fluid milk advertising, since both programs have identical objectives. The Dairy Program additionally has an objective to expand the market for cheese. Accordingly, part of its budget is directed to generic cheese advertising.

To examine the impacts that the two advertising programs had on the markets for fluid milk and cheese over this period, the economic model was initially simulated under two scenarios based on the level of generic advertising expenditures: (1) a baseline scenario, in which generic advertising levels were equal to actual generic advertising expenditures under the two programs, and (2) a no-national programs scenario, where there was no fluid milk processor-sponsored advertising, and dairy farmer-sponsored advertising was reduced to 42 percent of actual levels to reflect the difference in assessment before and after the national programs were enacted. A comparison of these scenarios provides a measure of the combined impacts of the two programs.[5]

[5] In order to conduct the market simulation, supply equations were estimated at the farm level and retail and wholesale levels for fluid milk and cheese. The supply equations, time-varying parameter demand equations for fluid milk and cheese, and identifying restrictions to close the model were included in the market simulation.

Table 3–3 presents the annual averages for supply, demand, and price variables over the period 1999–2003 for the two scenarios. Generic advertising by the Dairy and Fluid Programs has had a positive impact on fluid milk consumption over this period. Specifically, fluid milk consumption would have been 4.5 percent lower had the two national advertising programs not been in effect. Likewise, generic cheese advertising under the Dairy Program had a positive impact on cheese consumption, i.e., consumption would have been 1.2 percent lower without generic advertising. Consumption of milk used in all dairy products would have been 2.0 percent lower had these two programs not been in effect.

Generic advertising by dairy farmers and milk processors had an effect on the farm milk price and milk marketings. The simulation results indicate that the all-milk price would have been $1.01 per hundredweight lower without generic advertising provided under the two programs. The farm milk price impacts resulted in an increase in farm milk marketings. That is, had there not been the two advertising programs, farm milk marketings would have been 2.1 percent lower due to the lower milk price.

A third scenario was subsequently simulated to measure the market impacts of the advertising program supported by the 15-cent checkoff program by dairy farmers. This scenario assumes that the advertising program operated by the fluid milk processors is still in effect. As in the earlier scenario, advertising expenditures by dairy farmers were reduced to 42 percent of actual levels to reflect the situation prior to the enactment of the Dairy Program. A comparison of this third scenario with the baseline scenario gives a measure of the advertising market impacts of the current mandatory Dairy Program.

The last two columns of Table 3–3 present the results of this scenario. Had there not been fluid milk and cheese advertising sponsored by dairy farmers, fluid milk demand would have been 0.6 percent lower, cheese demand would have been 1.8 percent lower, and total milk demand would have been 0.9 percent lower than it actually was. Advertising under the Dairy Program also had a significant impact on the farmer milk price. The simulation results indicate that the all-milk price would have been $0.39 per hundredweight lower without generic advertising by the Dairy Program. Finally, farm milk marketings would have been slightly lower (1.0 percent) in the absence of the Dairy Program. Table 3–5 presents a description of variables used in the model.

Benefit-Cost of Advertising by the Dairy Program

One way to measure whether the benefits of a program outweigh the cost is to compute a benefit-cost ratio (BCR). A BCR can be computed as the change in net revenue due to advertising divided by the cost of advertising. While a BCR for producers can be estimated for the Dairy Program, it cannot be computed at this time for milk processors with the Fluid Program because data on packaged fluid milk wholesale prices, which are necessary in calculating processor net revenue, are proprietary information and not available.

The BCR for the Dairy Program was calculated as the change in dairy farmer net revenue (what economists call "producer surplus") due to the demand enhancement from advertising under the

Table 3–3. Simulated Impacts of the Dairy and Fluid Milk Programs on Selected Market Variables, Annual Average 1999–2003

		Baseline Scenario[1]	No National Program Scenario[2]		No Dairy Program Scenario[3]	
Market Variable	Unit	Level	Level	% Difference	Level	% Difference
Fluid Milk Demand	Bil lbs	55.3	52.8	−4.5	55.0	−0.6
Cheese Demand	Bil lbs MFE	70.5	69.6	−1.2	69.2	−1.8
Total Dairy Demand	Bil lbs	164.1	160.7	−2.0	162.6	−0.9
Basic Formula Price	$/cwt	11.45	10.55	−7.8	11.07	−3.3
All Milk Price	$/cwt	13.25	12.24	−7.6	12.86	−2.9
Milk Marketings	bil lbs	167.2	163.5	−2.1	165.6	−1.0
Benefit-Cost Ratio[4]	$ per $1				6.58	

[1] Baseline scenario reflects the current operation of the Dairy and Fluid Milk Programs.
[2] No National Program Scenario reflects no Fluid Milk Program and Dairy Program advertising at prenational program spending levels.
[3] No Dairy Program Scenario reflects current Fluid Milk Program and Dairy Program advertising at prenational program spending levels.
[4] Benefit-cost ratio computed for the Dairy Program only.

Dairy Program divided by the advertising costs.[6] The demand enhancement reflects increases in quantity and price as a result of the advertising program. Direct media advertising expenditures are used in the demand model (i.e., air time, print space, and other direct media costs) as a proxy for advertising exposure to consumers. However, to appropriately reflect the true complete costs of the advertising program and compute a return to producers who fund the advertising efforts, it is necessary to incorporate expenses that reflect general administration, overhead, and advertising production costs. Following conversations with staff at DMI and a review of Dairy Programs budgets, direct media expenditures were prorated upward by a factor of 1.25. The results show that the average BCR for the Dairy Program was 6.58 for the 1999 through 2003 period. This means that each dollar invested in generic fluid milk and cheese advertising by dairy farmers during the period returned $6.58, on average, in revenue to farmers.

Another way to interpret this figure is as follows. The increase in generic advertising expenditures resulting from the Dairy Program cost dairy producers an additional $61 million per year on average (i.e., the difference between $107 million annually under the baseline scenario and $46 million under the no Dairy Program scenario.) The additional fluid milk and cheese advertising resulted in higher demand, prices, and net revenue for dairy producers nationwide. Based on the simulations conducted, it is estimated that the average annual increase in producer surplus (reflecting changes in both revenues and costs) due to the additional advertising under the Dairy Program was $402 million. Dividing $402 million by the additional advertising costs of $61 million results in the BCR estimate of 6.58.

The level of this BCR suggests that the generic advertising program supported by dairy farmers has been a successful investment. Questions often arise with respect to the accuracy of these BCR estimates, especially in relation to recent low commodity prices and financial stresses faced by producers. BCRs are generally large because advertising expenditures in relation to product value are small and, as such, only a small demand effect is needed to generate positive returns. For example, the change in advertising expenditures above is less than 0.5 percent of the value of farm milk marketings. An increase in generic advertising increased producer net revenue by over $400 million per year but still represents only about 2 percent of the value of farm milk production. The advertising activity resulted in modest gains in total milk utilization and a positive effect on milk prices, resulting in positive net revenue to the advertising investment. While the positive price effects were not sizable enough to sufficiently counter low prices recently received by dairy farmers, generic advertising did improve demand and prices to dairy farmers relative to a non-advertising scenario, providing a return on the investment that clearly supports the program.

Section II: Analysis of All Demand-Enhancing Activities

The above analysis evaluated the generic fluid milk and cheese advertising programs, which have historically been the most important marketing activity invested in by dairy farmers and milk

[6] "Net revenue" can be defined as the aggregate revenue gains from price and product disappearance enhancements less the increased supply costs.

processors. However, an increasing trend toward investment in nonadvertising promotion activities (NAPA) has occurred over the past 2 years (particularly in the Dairy Program). Thus, it is becoming increasingly important to take NAPA into account when evaluating the Fluid and Dairy Programs. Historically, a lack of adequate data has prevented a more encompassing analysis of promotion efforts. Additional efforts to acquire the needed data were pursued this year, and it is expected that as the length of the time frame of available data continues, the modeling results and analysis will be improved.

To account for both generic advertising and NAPA, a combined fluid milk-cheese demand model was estimated that included all demand-enhancing marketing activities as one of the demand determinants.[7] As was the case before, per capita commercial disappearance of fluid milk and cheese was used to represent dairy demand. Expenditures for the following marketing activities were aggregated into one variable assumed to impact fluid milk and cheese demand: total dairy farmer expenditures for generic milk and cheese advertising, public relations, nutrition education, and the Unified Marketing Plan; and total milk processor expenditures for generic milk advertising, public relations, and promotions.[8] In addition, the following variables were included as factors influencing combined per capita fluid milk and cheese demand: (CPI) for all dairy products, per capita disposable income, variables to capture seasonality in dairy product demand, and per capita FAFH.

The model was estimated with national, quarterly data from 1990 through 2003. To account for the impact of inflation, all monetary variables were deflated by the CPI for all items. Unlike the time-varying parameter model used to estimate the advertising impacts, a constant-parameter model was used to estimate the aggregate fluid milk and cheese demand equation. The constant-parameter model is appropriate here since a relatively short period of time series data was used in this analysis, unlike the analysis of advertising which used data going back to 1975.

Table 3–4 provides selected elasticities for the combined fluid milk-cheese demand model. The results are similar to those found in the time-varying parameter models for fluid milk and cheese, and all demand elasticities were statistically significantly different from zero. The most important factor in the model impacting per capita disappearance of milk and cheese was the retail price of dairy products. The average price elasticity over the time period of 1990 through 2003 was –0.392, i.e., a 1.0 percent increase in the retail price of dairy products resulted in a 0.392 percent decrease in per capita quantity demanded for fluid milk and cheese products. Per capita FAFH expenditures also had a significant impact on demand. The results indicated that a 1.0 percent increase in per capita FAFH expenditures resulted in a 0.289 percent increase in fluid milk and cheese demand. Thus, the trend toward eating away from home has helped increase total consumption of dairy products. Income had a smaller impact on per capita fluid milk and

[7] Well over 90 percent of the combined marketing budgets by dairy farmers and milk processors are spent on fluid milk and cheese advertising and promotion activities. Hence, focusing on these two commodities is sufficient for evaluating the overall marketing effort of the Dairy and Fluid Programs.

[8] The Unified Marketing Plan represents an advertising and promotion marketing plan coordinated by DMI that receives designated funding from the State, local, and regional dairy product promotion organizations as part of their joint efforts.

Table 3–4. Average Elasticity Values (1990–2003) for Factors Affecting the Combined Retail Demand for Fluid Milk and Cheese

Variable	Elasticity
Retail price	−0.392*
Per capita income	0.071**
Per capita food away from home expenditures	0.288*
Generic advertising and promotion	0.046*

*Significant at the 10 percent significance level or less.
**Significant at the 15 percent significance level.

cheese demand (its elasticity averaged 0.079), but its positive sign indicates that these dairy products are normal goods, i.e., consumption increases with increases in income.

The major interest here is the combined advertising and promotion (or "marketing") elasticity. The average marketing elasticity for this period was 0.046, i.e., a 1.0 percent increase in expenditures for these combined marketing activities increased fluid milk and cheese demand by 0.046 percent. This result is similar to the advertising elasticities computed earlier in this report. However, this elasticity applies to all demand-enhancing activities by dairy farmers and milk processors. Thus, the total marketing effort by dairy farmers and milk processors has had a positive and statistically significant impact on dairy consumption.

A BCR can be computed as the change in net revenue due to all demand-enhancing marketing activities divided by the cost of the programs. As was the case before, while a BCR for producers can be estimated for the Dairy Program, it cannot be computed for milk processors with the Fluid Program because data on packaged fluid milk wholesale prices, which is necessary in calculating processor net revenue, are proprietary information and not available.

Following the same procedures used in the advertising evaluation,[9] the BCR was calculated by simulating two scenarios: (1) a baseline scenario, in which combined marketing levels were equal to actual marketing expenditures under the two programs, and (2) a no-national Dairy Program scenario in which there was fluid milk processor-sponsored marketing, but dairy farmer-sponsored marketing was reduced to 42 percent of actual levels to reflect the difference in assessment before and after the national program was enacted. A comparison of these two scenarios provides a measure of the impact of the Dairy Program. The benefits of the Dairy Program were calculated as the change in dairy farmer net revenue due to demand enhancement from all marketing activities under the Dairy Program, i.e., the difference in net revenue between Scenarios 1 and 2. The costs of the Dairy Program were calculated as the difference in total assessment revenue before and after the national program was enacted.

[9] In order to measure market impacts, a supply equation at the farm-level was also estimated to simulate supply response to any price increase due to a marketing-induced increase in demand.

The results show that the average BCR for the Dairy Program was 4.61 from 1999 through 2003. This means that each dollar invested in fluid milk and cheese marketing (advertising and NAPA) by dairy farmers during the period returned $4.61, on average, in net revenue to farmers. While slightly lower than the advertising-only BCR, the level of the marketing BCR suggests that the combined marketing programs supported by dairy farmers have been a successful investment.

Table 3–5. Description of Variables Used in Econometric Models[1]

Variable	Description	Units	Mean[2]
	Consumption Variables		
RFDPC	Quarterly retail fluid demand per capita	lbs. MFE	48.48 (1.44)
RCDPC	Quarterly retail cheese demand per capita	lbs. MFE	61.88 (2.45)
RBDPC	Quarterly retail butter demand per capita	lbs. MFE	24.33 (3.23)
RFZDPC	Quarterly retail frozen demand per capita	lbs. MFE	12.26 (1.92)
FMS	Quarterly fluid milk production	bil. lbs.	41.79 (1.20)
	Prices and Price Indices		
RFPBEV	Consumer retail price index for fresh milk and cream, deflated by consumer price index for nonalcoholic beverages (1982–84=1)	#	1.16 (0.03)
RCPMEAT	Consumer retail price index for cheese, deflated by consumer retail price index for meats (1982–84=1)	#	1.04 (0.03)
WFP	Wholesale fluid price index (1982–84=1)	#	1.50 (0.07)
WCP	Wholesale cheese price	$/lb.	1.30 (0.20)
MW	Basic formula price	$/cwt.	11.45 (1.95)
AMP	All milk price	$/cwt.	13.25 (1.59)
DIFF	Class I differential	$/cwt.	3.59 (1.73)
PFE	Producer energy index (1982–84=1)	#	1.09 (0.11)
	Demographic Variables		
INCPC	Per capita disposable income, deflated by the consumer retail price index for all items (1982–84=1)	$000	14.80 (0.39)
BLACK	Percent of the population African American	#	11.96 (0.19)
HISPANIC/ASIAN	Percent of the population Hispanic/Asian	#	4.92 (0.15)
AGE5	Percent of the population under age 6	#	6.82 (0.08)
AGE2044	Percent of the population age 20 to 44	#	36.17 (0.52)
FAFHPC	Real per capita food away from home expenditures (1988$)	$	244.38 (4.80)
	Advertising Expenditures		
GFAD	Quarterly generic fluid milk advertising expenditures, deflated by Media Cost Index (2001$)	$mil	28.80 (6.70)
GFAD_DMI	Quarterly generic fluid milk advertising expenditures, Dairy Program, deflated by Media Cost Index (2001$)	$mil	8.66 (3.93)
GFAD_MILKPEP	Quarterly generic fluid milk advertising expenditures, Fluid Milk Program, deflated by Media Cost Index (2001$)	$mil	20.09 (5.75)
GCAD	Quarterly generic cheese advertising expenditures, Dairy Program, deflated by Media Cost Index (2001$)	$mil	12.58 (2.36)
BFAD	Quarterly brand fluid milk advertising expenditures, deflated by Media Cost Index (2001$)	$mil	5.06 (2.51)
BCAD	Quarterly brand cheese advertising expenditures, deflated by Media Cost Index (2001$)	$mil	21.88 (9.94)

[1] Quarterly dummy variables (Q1-Q3) are also included in the model to account for seasonality in demand.
[2] Computed over most recent 5-year period, 1999–2003. Standard deviation in parentheses.